where they may be quite broad, they have strongly suggested the "dawn" or glow that precedes a bright moonrise. Their luminosity is uniformly steady.

The reason I refer to this matter as haze, and the reason I think it is only ordinary haze made self-luminous, is because on one occasion I watched a mass of it in the north-western sky which was slowly drifting northerly in the region of the great "dipper" of Ursa Major as daylight came on. These hazy luminous strips had been visible all the latter part of the night—new strips coming and going slowly, sometimes several being seen at once. As daylight killed them out I noticed, when the light had increased sufficiently, that there were strips of ordinary haze exactly the same in form and motion, and occupying the same region of the sky. I am sure they were the same masses that had appeared luminous on the night sky. My impression, therefore, is that these hazy luminous strips were only the ordinary haze which had for some reason become self-luminous. I am specially certain that these masses are not luminous as a result of any great altitude which might bring them within reach of the sun's light, for they were frequently seen in such positions that the sun's rays could never reach them. The sun or moon, therefore, had nothing to do with their illumination. It is also needless to say that they are not related to the pulsating auroral clouds which I have previously mentioned.

I have not noticed this luminous haze in former years, though it may have been present; and did it not seem unreasonable, one might suspect some relation between this condition of the atmosphere and the possible passage of the earth through a portion of the tail of Halley's comet on May 19, 1910.

It seems to me that these objects should be observed and a record made of the times of their visibility and their motion, &c. It would be valuable to have records of them from different stations to see if their luminosity is due to some general condition of the earth's atmosphere at the time. It is not probable that this luminosity is in any way due to local conditions. In the records here given, it is possible that on one or two occasions an aurora was also present, but I have tried to confine the accounts to what I have called, and believe to be, self-luminous haze. They were not seen previous to June 7, 1910.

[Prof. Barnard then gave details of observations made on various dates from June 7, 1910, to March 2, 1911.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

An advanced course of instruction on "The Systematic Design and Manufacture of Dynamo-electric Machinery" will be given at the City and Guilds (Engineering) College, South Kensington, during the forthcoming session, under the general supervision of Prof. T. Mather, F.R.S., professor of electrical engineering at the college. The course is to prepare men to take up positions as designers in electrical works. It will deal with present-day problems in design, construction, and testing, in a thoroughly practical manner. An experienced designer and draughtsman, specially engaged for the purpose, will devote his whole time to the drawing-office work in connection with the course. The course is intended for post-graduate and other duly qualified students, the number of which will be strictly limited. Application for admission to the whole course, or parts thereof, should be made by letter to the Dean, City and Guilds (Engineering) College, Exhibition Road, London, S.W.

The President of the Board of Education has appointed a departmental committee to inquire and report—(*a*) Whether it would be inconsistent with due regard to educational and hygienic considerations that the *minimum* standard of playground accommodation for new public elementary schools prescribed in the Building Regulations of the Board of Education—viz. 30 feet per head of accommodation—should be modified or adjusted according to the size, design, or situation of schools, the proximity of recreation grounds or open spaces, the density of population, the cost of land, or otherwise. (*b*) How far it is possible or desirable to define more precisely the standard of playground accommodation which the Board of Education will require under the Code of Regulations for Public Elementary Schools in the case of existing schools or to regulate the practice of the Board of Education in dealing with cases in which the playground accommodation is considered to be insufficient. The committee will consist of Mr. L. A. Selby-Bigge, C.B., principal assistant-secretary of the Elementary Education Branch of the Board of Education (chairman); Sir George Newman, chief medical officer of the Board of Education; Mr. J. C. Iles, H.M.I., divisional inspector for the North-western Division; Mr. F. H. B. Dale, H.M.I., divisional inspector for the Metropolitan Division; Mr. A. B. McLachlan, of the Local Government Board; with Mr. L. J. Morison as secretary.

The latest report of the U.S. Commissioner of Education gives some interesting statistics of the so-called land-grant colleges, established under the provisions of the Act of Congress of July 2, 1862, and receiving aid from the Federal Government from funds provided by Acts of Congress of 1890 and 1907. Each State received from the U.S. Treasury during the year ended June 30, 1910, the sum of 8000*l*. for the benefit of these land-grant colleges—commonly called agricultural and mechanical colleges—making a total of 400,000*l*., exclusive of the sums paid for experiment-station purposes, expended by the Federal Government in aid of these colleges. There are sixty-eight of these institutions, sixteen of which are separate institutions for the coloured race. These colleges are in a period of rapid growth, shown by a marked increase in the number of instructors and students and the value of their property and income. The total number of instructors during the year in all departments of the sixty-eight colleges was 6665, of which 742 were women. The total number of students enrolled for the year was 80,646, an increase of 9·6 per cent. over the preceding year. The total value of the property held for the benefit of these colleges amounts to 23,568,600*l*., an increase for the year of 910,000*l*. The total income from all sources, excluding the grants for experiment stations, was for the year about 4,180,000*l*., an increase of some 459,000*l*. during the year.

The "Directory for Higher Education, 1911–12," issued by the Education Committee of the Staffordshire County Council, contains the regulations of the committee and details of schemes in operation throughout the county. Very complete provision is made for technological instruction, and among the subjects catered for the following may be mentioned:—Instruction in mining is provided by means of lecturers, whose whole time is devoted to the work, and their assistants. For this purpose the county is divided into two portions, comprising the North Staffordshire coalfields and the South Staffordshire coalfields respectively. Theoretical and practical classes in metallurgy and iron and steel manufacture are conducted in accordance with the regulations of the Board of Education and the City and Guilds of London Institute. Instruction is also provided in pottery and porcelain manufacture, boot and shoe manufacture, silk manufacture, and in wrought-iron work. In order to enable teachers in elementary and secondary schools to impart instruction in various branches of technical and manual training, the committee provides special classes at convenient centres. In localities where suitable instruction is provided already, classes in approved subjects are recognised by the committee, and with the object of encouraging the attendance of teachers at such classes, grants towards their railway fares are made. The work of the committee in rural districts falls under three heads: instruction directly supplied in special subjects, viz. agriculture, horticulture, hygiene, domestic subjects, and wood-carving and drawing; evening schools taught by local teachers, and earning a grant from the Board of Education; and experimental and demonstration plots.

The Charity Commission has given notice that it proposes to make an order establishing a scheme for the future regulation of the People's Palace in East London. The scheme sets forth that with reference to the administration of the East London College, in connection with

© 1911 Nature Publishing Group

the Palace, by the Council, the charity and its endowments shall be administered by a body of governors fifteen in number. Of these the master and clerk of the Drapers' Company shall be two, the Drapers' Company shall nominate six, the Central Governing Body two, the County Council one, and four shall be coopted members. So long as university education is carried on by the Council in the present college premises, the governing body shall grant the use of them at a rent of 1*l.* per year. The scheme goes on to state that the Drapers' Company shall pay to the governing body the sum of 7000*l.* per annum. The company may, however, discontinue such payment on giving notice and, at the expiration of five years, paying for the purpose of the scheme the sum of 30,000*l.* If at the date whereon the payment of 30,000*l.* becomes due university education is being carried on in the present college premises, the money shall be applicable for the future maintenance of the East London College as may be directed by the Board of Education. So long as university education is carried on and the annual payment from the Drapers' Company is received, the amount is to be paid for the purposes of the East London College, and the scheme determines that the part of the endowment of the charity which is held for educational purposes consists of the present college premises, so long as university education is carried on there, the sum of 7000*l.* per annum so long as it is paid by the Drapers' Company or the 30,000*l.* to be paid by the company in the event of the discontinuance of the annual payment. The educational endowment is to be administered under the title of the East London College as a separate educational foundation for the promotion of university education.

WE learn from *The Pioneer Mail* that new buildings of the Poona Agricultural College were opened by Sir George Clarke, the Governor of Bombay, on July 18. The college at present consists of two large buildings, and another is in course of construction. In the main building all work except that relating to chemistry and physics will be done, the smaller one adjoining being devoted solely to these latter subjects. The complete course at the college lasts three years and includes practical farming, general chemistry, botany, agricultural engineering, veterinary science, agricultural climatology, entomology, and so on. During the course of his address Sir George Clarke said there is only one fault in the Bombay Agricultural Department: it is far too small, in comparison with the needs of cultivators and the vast magnitude of the task which it has undertaken. "If I were an Indian politician," he continued, "I should worry Government, in season and out of season, to spend more money upon the improvement of agriculture and the acquisition and spread of knowledge. We require much more research work because the problems of India are her own, and careful investigations carried on in other countries may be valueless in our special conditions. We want more demonstration farms where cultivators can receive an object-lesson by which the advantages of improved methods can be brought home to their minds. I should like to see many more lecturers employed in going about among villages to instil new ideas and to awaken interest. I think we should also establish rural schools where the elements of practical agriculture could be taught in the vernacular. The demands upon the Government are now so many and so insistent that we cannot do all we wish. If the nature and vast importance of agricultural work were more widely known, I am certain that our many wealthy and generous philanthropists would come forward to help. There can be no better proof of patriotism and no better way of promoting prosperity than the increase and development of the production of the land, which lies within our power if adequate means were available."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society.—Prof. J. H. **Poynting**: Small longitudinal material waves accompanying light waves. (Received July 26.)

All experiments on the pressure of light agree in showing that there is a flow of momentum along the beam. This flow is manifested as a force on matter wherever there is a change of medium. When the light is absorbed, the momentum is absorbed by matter. When the beam is shifted parallel to itself there is a torque on the matter effecting the shift. The momentum would therefore appear to be carried by the matter, and not merely by the æther. Though there is an obvious difficulty in accepting this view when the density of the matter is so small as it is in interplanetary space, it appears to be worth while to follow out the consequences of the supposition that the force equivalent to the rate of flow of momentum across a plane perpendicular to a beam of light acts upon the matter bounded by the plane. This rate of flow per square centimetre is equal to the energy density or energy per cubic centimetre in the beam. Of course, in experiments, only the average of the rate of flow during many seconds and the average energy per cubic centimetre in a length of beam of millions of miles is actually measured. But on the electromagnetic theory of light, which suggested the experiments and gives the right value for the pressure, this pressure is equal to the energy density at every point of a single wave.

Let us suppose that we have a train of plane polarised electromagnetic waves of sine form, the magnetic intensity being given by

$$\mathrm{H}=\mathrm{H}_1 \sin \frac{2\pi}{\lambda}(x-vt),$$

where H_1 is the amplitude of H. The electromagnetic energy per unit volume is $\mu\mathrm{H}_1{}^2/8\pi$, and

$$\frac{\text{Energy in longitudinal waves}}{\text{Electromagnetic energy}}=\frac{\mu\mathrm{H}_1{}^2}{32\pi\rho v^2}=\frac{1}{8}\frac{\mu\mathrm{H}_1{}^2}{8\pi}\Big/\frac{\rho v^2}{2}$$

which is one-eighth of the electromagnetic energy divided by the energy which the matter would have if it were moving with the velocity of light in that matter.

This shows how infinitesimal is the fraction of the energy of the beam which is located in these waves of compression of the material.

The fraction is proportional to the intensity of the beam.

As an example, take a beam of the intensity of full sunlight just outside the earth's atmosphere, in which the energy flow is about $1{\cdot}4\times10^6$ ergs/sec. The energy density $\mu\mathrm{H}_1{}^2/8\pi$ is therefore $1{\cdot}4\times10^6\div v$. Put $v=3\times10^{10}/n$, where n is the refractive index. The fraction is

$$\frac{1}{4}\cdot\frac{1{\cdot}4\times10^6\ n^3}{27\times10^{30}\ \rho}, \text{ or about } 1{\cdot}25\times10^{-26}n^3/\rho.$$

At the surface of the sun it would be about 40,000 times as much; say $5\times10^{-22}n^3/\rho$.

It is interesting to note that if a beam of light is incident on any reflecting or absorbing surface, and if the pressure of light is periodic with the waves, it must give rise to ordinary elastic waves in the material of frequency double that of the light waves.

EDINBURGH.

Royal Society, July 14.—Sir William Turner, K.C.B., president, in the chair.—Prof. F. A. **Forel**: Refractions at the surface of a lake, mirages, and *fata morgana*. In discussing mirages and refraction effects over the surface of a lake, one must distinguish between refractions in air over warm water and refractions in air over cold. In the former, with the warm layers below, the curve of refraction is concave upward; in the latter it is convex; and the horizon is, respectively, elevated above and depressed below its normal position. On a summer day, as the temperature of the air changes from being lower to being higher than the temperature of the water, there appears a phenomenon called by the Italian men of science the *fata morgana*. It has the appearance of a series of rectangles, as if some great cliff or the quays of an enormous city extended along the opposite side of the lake. The higher line of this striated zone coincides with the horizon of the refraction over cold water, and the lower line is continuous with the horizon of the refraction over warm water. The *fata morgana* is the fusion of the two types of refractions as the one succeeds the other.—J. Y. **Buchanan**: Experimental researches on the specific gravity and displacement of some saline solutions.

© 1911 Nature Publishing Group